

# **Oil Spills Fate and Effects Modeling for Alternative Response Scenarios**

## **Part B: Delaware Bay and Mid-Atlantic Shelf**

### **Section B-II.6**

by

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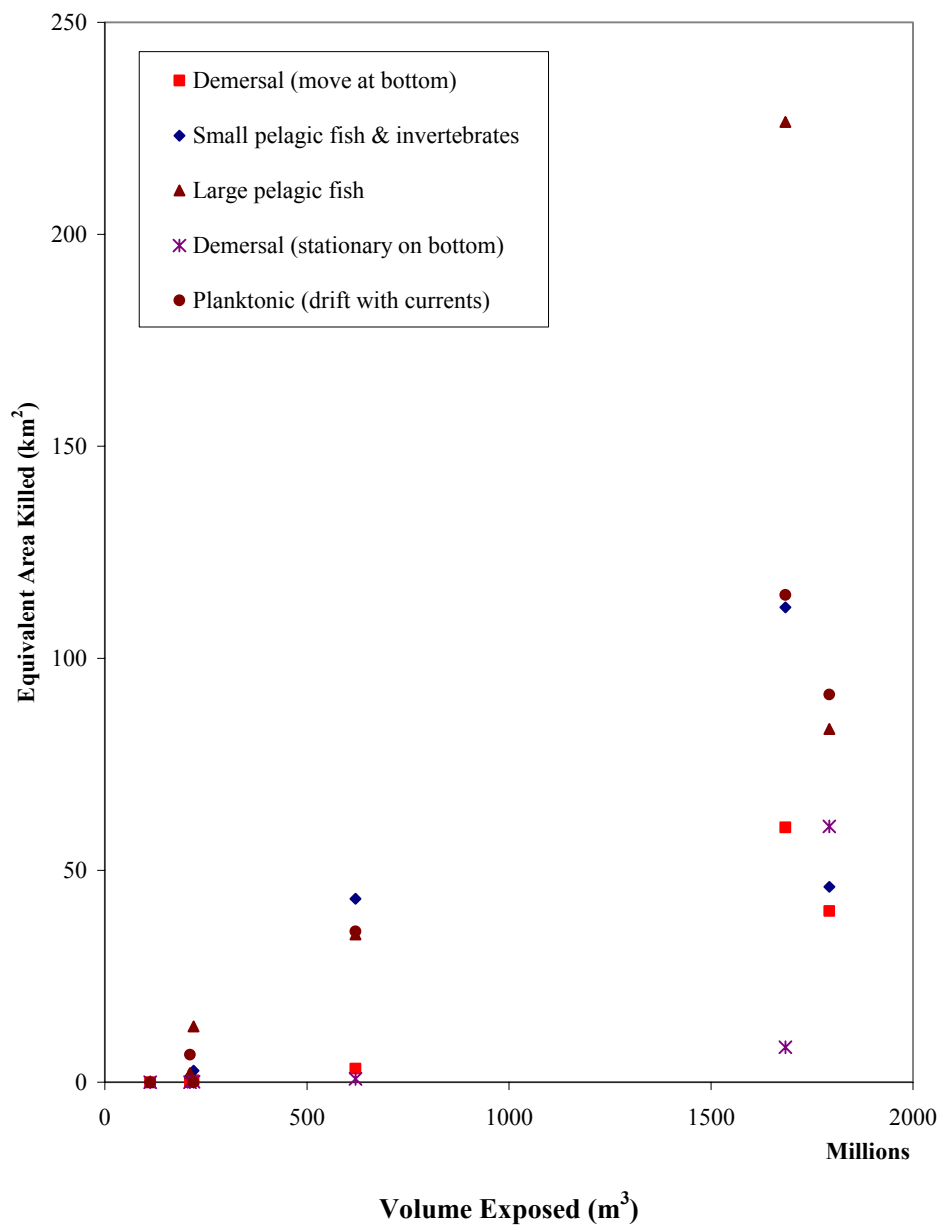
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## **B-II.6 Exposures for fish and invertebrates to dissolved aromatic concentrations.**

This appendix tabulates estimated mortality of water column, demersal (on the bottom) and benthic (in the bottom) organisms by behavior type for the Delaware Bay spill location. Effects are summarized as an equivalent area of 100% mortality by behavior group and habitat type. The equivalent area for 100% mortality is the integrated sum of equivalent area affected times percent mortality. For water column and demersal species, the equivalent area affected is calculated as water volume affected times the fraction of the water depth zone the behavior group occupies that the affected volume encompasses. For pelagic species, the depth zone occupied is the entire water column. For demersal species (on the bottom sediments, exposed to bottom water), the depth zone occupied is the bottom 1 meter of the water column. The methods and assumptions for these calculations are described in Part A.

For water column and demersal species, the mean equivalent area killed for all possible environmental conditions is calculated using the water volume ( $\text{m}^3$ ) exposed to greater than  $1 \text{ mg/m}^3$  (1 ppb) dissolved aromatic concentration at any time after the spill. The biological exposure model was run for the 50<sup>th</sup> percentile run (with respect to water volume exposed to >1ppb) of each of the six scenarios (two spill volumes times three dispersant conditions). The toxicity parameter (LC50) assumed in these calculations was that for sensitive species (the 2.5<sup>th</sup> percentile in rank order sensitivity), in order to provide conservatively high estimates of potential water column effects. The resulting equivalent areas of 100% mortality (in  $\text{km}^2$ ) were regressed against water volume exposed ( $\text{m}^3$ ) to obtain an equation for each behavior group that may be used to scale from volume exposed to area killed (for sensitive species). Figure B-II.6-1 plots equivalent water column area killed (area of 100% mortality) against volume exposed to >1ppb for each of the water column and demersal behavior groups. Table B-II.6-1 contains the regression slope, intercept, standard error, and correlation coefficient for each behavior group. Tables B-II.6-2 and B-II.6-3 contain estimated equivalent areas killed (for sensitive species) for mean environmental conditions, based on the mean volume exposed to >1ppb dissolved aromatic concentration (from Appendix B-II.2). Tables B-II.6-4 and B-II.6-5 contain estimated equivalent areas killed (for sensitive species) for 95<sup>th</sup> percentile environmental conditions, based on the mean plus two standard deviations of volume exposed to >1ppb dissolved aromatic concentration. Mean and standard deviation of volume exposed to >1ppb dissolved aromatic concentration are tabulated in Appendix B-II.2 and the full distribution of all 100 runs is plotted in Appendix B-II.3. The effects on water column communities are discussed in Sections B.3.2 and B.4.2.

Benthic effects are related to the bottom sediment area exposed to oil exceeding a threshold of concern. Table B-II.6-6 summarizes the loading of oil to the sediments. For most species, the dissolved aromatic concentration in the pore water of the sediments is what is bioavailable and causes toxicity (Table B-II.6-7). A threshold of 6 ppb dissolved aromatic concentration could cause effects on sensitive (2.5% of) species, whereas the threshold for average species is 50 ppb (see Part A, Section A.3.4). The effects on benthic organisms are discussed in Sections B.3.2 and B.4.2.



**Figure B-II.6-1. Equivalent area killed (for sensitive species) against volume exposed to > 1ppb dissolved aromatic concentration for water column behavior groups.**

**Table B-II.6-1 Regression slope, intercept, standard error, and correlation coefficient for equivalent water column area killed (km<sup>2</sup>) against water volume exposed to >1ppb (m<sup>3</sup>), based on the 50<sup>th</sup> percentile runs of each scenario.**

Behavior Group	Slope	Intercept	Std Error	Correlation
Demersal (move at bottom)	3.2231E-08	-7.5530	9.7128	0.944
Small pelagic fish & invertebrates	4.7451E-08	-2.4482	26.7630	0.836
Large pelagic fish	9.3951E-08	-12.6514	54.7115	0.828
Demersal (stationary on bottom)	2.3325E-08	-6.4503	18.0078	0.744
Planktonic (drift with currents)	6.3952E-08	-8.0356	11.3695	0.979

**Table B-II.6-2. Equivalent area (km<sup>2</sup>) of 100% mortality (for sensitive species) by water column behavior group, based on mean water volume exposed to > 1ppb dissolved aromatic concentration, for medium volume scenarios with indicated dispersant efficiencies.**

Behavior Group	0%	45%	80%
Demersal (move at bottom)	0.0	0.0	0.0
Small pelagic fish & invertebrates	3.7	8.5	8.4
Large pelagic fish	0.0	9.0	8.9
Demersal (stationary on bottom)	0.0	0.0	0.0
Planktonic (drift with currents)	0.2	6.7	6.6

**Table B-II.6-3. Equivalent area (km<sup>2</sup>) of 100% mortality (for sensitive species) by water column behavior group, based on mean water volume exposed to > 1ppb dissolved aromatic concentration, for large volume scenarios with indicated dispersant efficiencies.**

Behavior Group	0%	45%	80%
Demersal (move at bottom)	14.9	50.4	49.8
Small pelagic fish & invertebrates	30.7	82.8	82.0
Large pelagic fish	52.9	156.2	154.6
Demersal (stationary on bottom)	9.8	35.5	35.1
Planktonic (drift with currents)	36.6	106.9	105.8

**Table B-II.6-4. Equivalent area (km<sup>2</sup>) of 100% mortality (for sensitive species) by water column behavior group, based on mean plus two standard deviations (i.e., 95<sup>th</sup> percentile) of water volume exposed to > 1ppb dissolved aromatic concentration, for medium volume scenarios with indicated dispersant efficiencies.**

<b>Behavior Group</b>	<b>0%</b>	<b>45%</b>	<b>80%</b>
Demersal (move at bottom)	2.8	13.2	12.9
Small pelagic fish & invertebrates	12.8	19.4	19.0
Large pelagic fish	17.5	38.5	37.7
Demersal (stationary on bottom)	1.0	9.6	9.4
Planktonic (drift with currents)	12.5	26.2	25.7

**Table B-II.6-5. Equivalent area (km<sup>2</sup>) of 100% mortality (for sensitive species) by water column behavior group, based on mean plus two standard deviations (i.e., 95<sup>th</sup> percentile) of water volume exposed to > 1ppb dissolved aromatic concentration, for large volume scenarios with indicated dispersant efficiencies.**

<b>Behavior Group</b>	<b>0%</b>	<b>45%</b>	<b>80%</b>
Demersal (move at bottom)	52.5	106.6	107.8
Small pelagic fish & invertebrates	77.2	157.0	158.7
Large pelagic fish	152.9	310.8	314.3
Demersal (stationary on bottom)	38.0	77.2	78.0
Planktonic (drift with currents)	104.1	211.6	213.9



**Table B-II.6-6. Area (m<sup>2</sup>) of sediment exceeding indicated thresholds of total hydrocarbon loading per unit area (g/m<sup>2</sup>) under average environmental conditions, by spill volume and dispersant treatment.**

<b>Threshold (g/m<sup>2</sup>)</b>	<b>Medium 0%</b>	<b>Medium 45%</b>	<b>Medium 80%</b>	<b>Large 0%</b>	<b>Large 45%</b>	<b>Large 80%</b>
0	35,314,000	33,296,000	28,251,000	75,673,000	51,458,000	58,520,000
0.001	25,224,000	22,197,000	21,188,000	55,493,000	39,350,000	40,359,000
0.01	12,108,000	9,081,000	7,063,000	35,314,000	26,233,000	23,206,000
0.1	0.0	0.0	0.0	7,063,000	7,063,000	7,063,000
1	0.0	0.0	0.0	0.0	1,009,000	2,018,9000
10	0.0	0.0	0.0	0.0	0.0	0.0

**Table B-II.6-7. Area (m<sup>2</sup>) of sediment exceeding indicated thresholds of dissolved aromatic concentration in pore waters (mg/m<sup>3</sup> = ppb) under average environmental conditions, by spill volume and dispersant treatment.**

<b>Threshold (mg/m<sup>3</sup> = ppb)</b>	<b>Medium 0%</b>	<b>Medium 45%</b>	<b>Medium 80%</b>	<b>Large 0%</b>	<b>Large 45%</b>	<b>Large 80%</b>
1	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0